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Superconductivity and Metal Deposition

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Sputtering Around The Lab

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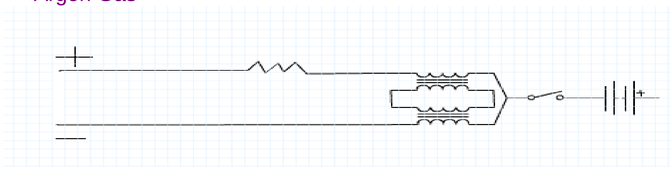
Abstract

The purpose of this research has a dual purpose. The first is to explore superconductivity. The second is the development of a new type of image intensifier. Both of these require the applying of thin layers of material through metal deposition.

To better understand the principles of superconductivity, aerogel disks are placed in a very low pressure environment (approximately 10^{-4} Pascals) with a large potential difference applied between electrodes. One of the electrodes being composed of a ceramic compound (barium yttrium copper oxide) which will be deposited onto the aerogel by way of sputtering metal depositionSputtering is the process of applying a potential difference across a gas, and ionizing the gas. The ions then collide with the sputter material ejecting material that collects on an aerogel . Once the disk has a uniform layer, further tests will be performed. In the case of the Yttrium and Barium, it is placed in liquid nitrogen to cool the disk to approximately 95 Kelvin. We hope that the surface structure and insulating properties of aerogels will produce unique qualities. In the case of a metal coating, we hope to examine electron amplification.

Set-up

- 2 transformers connected in parallel (output of 60mA and 15,oooV)
- Vacuum chamber
- Argon Gas



Circuit diagram of sputter system

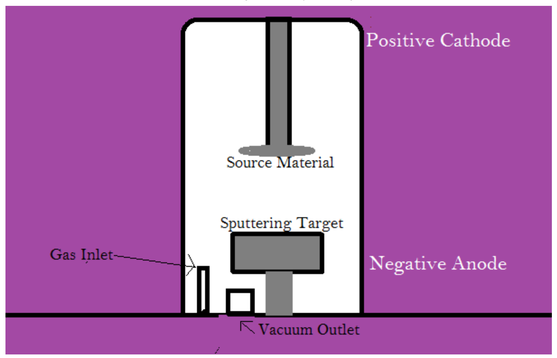


Diagram of sputter system

Experiment

Sputtering is the process of applying a potential difference across a gas, and ionizing the gas. The ions then collide with the sputter material ejecting material that collects on an aerogel . Once the disk has a uniform layer, further tests will be performed. In the case of the Yttrium and Barium, it is placed in liquid nitrogen to cool the disk to approximately 95 Kelvin.

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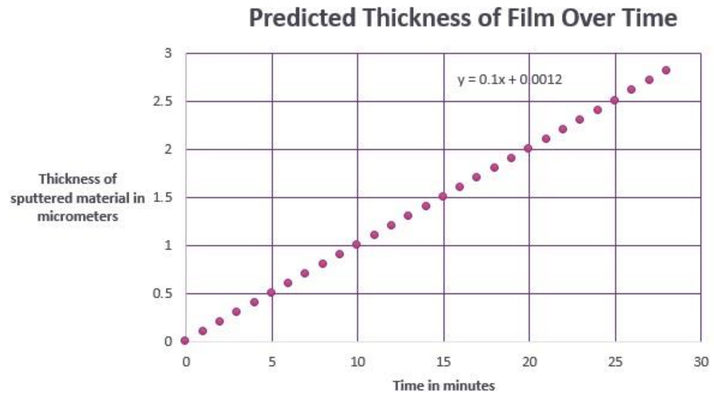
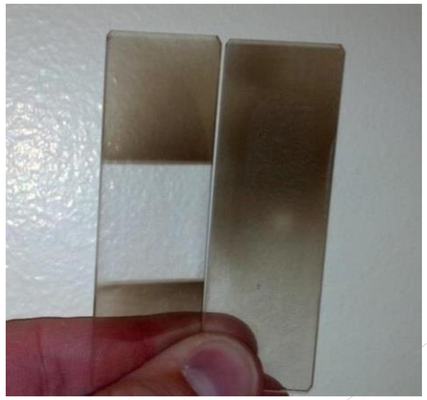


Results and Data

The initial results of the sputtering are promising. Argon was slowly leaked into the chamber. A potential difference was applied and over time a thin film gathered on the aerogel. The thin is of seemingly uniform thickness but awaits further testing.

Lead Coated Aerogel after 90 minutes



Lead coated Glass slides after 4 minutes

Analysis

Successes:

- Coating of aerogels appears to be uniform
- Argon gas ionizes and collides with the sputtering material with enough force to eject material
- Aerogel target surface has ability to hold sputtering material

Problems:

- Aerogel has a porous structure therefore the coating is not smooth
- Sputtering system imperfect and it may allow contamination of sputtering material

Conclusion and Future

The aerogel disks that have been coated with lead or aluminum can be used as complex diffraction gratings allowing us to examine the basic surface structure. The xerogels, which lack the porousness of the aerogel can be used as lenses.

The future of this research is in sputtering a ceramic compound (barium yttrium copper oxide) onto aerogels/xerogels to further investigate their superconductive properties and the Meissner Effect.

For further information on aerogels, or barium yttrium copper oxide, there are other posters presented by the physics department here at the symposium,,

Ionized Argon Gas